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Does Fall History Influence Residential Adjustments?

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Purpose of the study: To determine whether reported falls at baseline are associated with an older adult's decision to make a residential adjustment (RA) and the type of adjustment made in the subsequent 2 years. ***Design and Methods:*** Observations (n = 25,036) were from the Health and Retirement Study, a nationally representative sample of community-living older adults, 65 years of age and older. At baseline, fall history (no fall, 1 fall no injury, 2 or more falls no injury, or 1 or more falls with an injury) and factors potentially associated with RA were used to predict the initiation of an RA (i.e., moving, home modifications, increased use of adaptive equipment, family support, or personal care assistance) during the subsequent 2 years. ***Results:*** Compared with those with no history of falls, individuals with a history of falls had higher odds of making any RA. Among those making an RA, individuals with an injurious fall were more likely than those with no history of a fall to start using adaptive equipment or increase their use of personal care assistance. ***Implications:*** The higher initiation of RAs among fallers may indicate proactive steps to prevent future falls and may be influenced by interactions with the health care system. To optimize fall prevention efforts, older adults would benefit from education and interventions addressing optimal use of RAs before falls occur.

Key Words: Environmental modification, Accidental falls, Person–environment fit

A fall can be a devastating event for older adults, resulting in increased activity limitation, disability, and institutionalization (Stel, Smit, Plujim, & Lips, 2004; Stevens, Corso, Finkelstein, & Miller, 2006; Tinetti & Williams, 1997). When faced with a potential decline in function, aging Americans prefer to remain in the community (AARP, 2003), to live in the least restrictive environment, and to avoid institutionalization (Horgas & Abowd, 2004). One strategy to maximize independence and remain in the community is to make a residential adjustment (RA) in which a person's needs are supported by adapting the environment or increasing the use of personal assistance (Gottlieb, Stoeckel, & Caro, 2009). Thus, initiating RAs can help enhance the person–environment fit (Lawton & Nahemow, 1973), and the type of RA may vary according to the individual's needs and the environment in which they are living. These RAs may be initiated in anticipation of, or in response to, the changing health and functional status of the older adult (Choi, 1996; Litwalk & Longino, 1987; Mutchler, 1992) or through interactions with the health care system where recommendations of specific adjustments are made (Clemson, Cumming, & Roland, 1996; Gerson, Camargo, & Wilber, 2005; Nikolaus & Bach, 2003).

Despite the availability of information on home safety and fall prevention in health care and community-based programs, there is limited

evidence on the relationship between fall history and the decision to make RAs.

Types of RAs

RAs can take several forms including: making changes to the physical environment (e.g., the older adult moving to an alternate residence in the community or making a home wheelchair accessible), increasing physical assistance (personal care assistance) for activities of daily living (ADL) and instrumental activities of daily living (IADL); increasing family proximity (e.g., family member moving to live closer to the older adult); or increasing the use of equipment (e.g., mobility aids, such as canes or walkers, or safety equipment, such as grab bars, raised toilet seats, and bath seats) to match the needs of the individual.

Research examining the initiation of various forms of RAs has been predominantly focused on the relationship between specific RAs and changes in health and functional status (e.g., Choi, 1996; Litwalk & Longino, 1987; Miller, Longino, Anderson, James, & Worley, 1999). For example, the receipt of formal and/or informal personal care assistance is strategies to delay or reduce the risk of institutionalization among individuals with self-care limitations (Avery, Speare, & Lawton, 1989; Mausbach et al. 2004 ; Miller et al., 1999). Changes in the older adult's living arrangements have been associated with seeking social support, family ties, and changing health (Choi, 1996). The proximity of the family has been postulated to serve as a buffer, facilitating the ability of the older adult to cope with changes in health and functional status (Choi, 1996). The older adult may chose to move closer to family as a result of declining health or the family may move in with the older adult to provided support to the older adult. Making changes to the physical environment to meet the needs of the older adult is another strategy to limit or delay institutionalization. Modifications to the home environment (i.e., wheelchair accessible doorways) and the use of adaptive equipment (e.g., shower seat, grab bars) have been associated with maximizing independent function, limiting caregiver burden, promoting safety of the older adult and the caregiver (Kutty, 2000; Mann, Ottenbacher, Fraas, Tomita, & Granger, 1999; Tabbarah, Silverstein, & Seeman, 2000; Verbrugge, Rennert, & Madans, 1997), and decreasing the risk of falls (Lord, Menz, & Sherrington, 2006; Nikolaus & Bach, 2003).

Adaptive equipment which includes safety equipment (i.e., shower seats and grab bars) and mobility aids (i.e., wheelchairs, walkers, and canes) can be used to limit task demand (Verbrugge & Sevak, 2002), prevent injury in individuals with mobility limitations (Resnik & Allen, 2006), limit hours of personal care assistance for those with ADL limitations (Agree, Freedman, Cornman, Wolf, & Marcotte, 2005; Allen, Foster, & Berg, 2001; Hoenig, Taylor, & Sloan, 2003), and encourage independence and autonomy (Allen et al., 2001; Verbrugge et al., 1997).

Falls and RAs

Despite the potential negative impact that fall events have on the ability of the older adult to remain in the community (Stel et al., 2004; Tinetti & Williams, 1997), there has been limited research on the relationship between fall history and the initiation of various RAs as protective strategies to achieve optimal person–environment fit. Whereas fall history has been associated with the initiation of home modifications (i.e., the installation of grab bars and making environments wheelchair accessible) (Tabbarah et al., 2000) and the older adults' expectations to move to an alternate residence (Stoekel & Porell, 2010), the relationship between fall history and the types of RAs remains unclear.

Conceptual Framework

The examination of whether or not fall history is associated with the older adults' decision to make any RA and the type of RA initiated was guided by Wiseman and Roseman's (1979) migration theory and Lawton and Nahemow (1973) Competence–Environmental Press model (CEPM). Wiseman and Roseman postulate moving to a new residence is a two-part decision process that includes (a) the evaluation and decision of whether or not a move is needed and (b) if the older adult decided that a move is warranted, what characteristics would be important in this new environment for the individual. They propose the decision to move is prompted by a change in personal status (e.g., change in functional status, or change in family and/or financial status) and influenced by the older adults' perceptions of their current environment, their abilities, and expected needs (Wiseman & Roseman, 1979).

The CEPM provides the framework to explore the interaction between the person and the environment,

which when optimized can result in maximum function or when poor can result in functional decline and/or potentially an increased risk of falling. In the CEPM, the environment can refer to the physical, personal, and/or the social environment, whereas the person is defined by his "competence" and includes the individual's biological health, functional status, and cognitive skills (Lawton & Nahemow, 1973). Figure 1 presents the integrated conceptual framework for this study in which the fall event (a personal status change) may be the event that highlights a mismatch between the environment and the person (Stoeckel & Porell, 2010), facilitating the RA decision process to achieve optimal function in the environment. It was hypothesized that as falls increase in number and severity, older adults may be more likely to initiate RAs.

In addition to examining the proportion of people who make RAs and the type of RA made, we examined the following research questions: (a) Are older persons who report one or more falls or at least one injurious fall more likely to make any RA than non-fallers? (b) Among those who made any RA, does the type of RA vary by fall history? Because previous research has identified the importance of maximizing independence, autonomy, self-reliance, and limiting dependence on other individuals (Allen et al., 2001; Mann, Llanes, Justiss, & Tomita, 2004; Verbrugge et al., 1997), it was hypothesized that older adults who experience fewer falls and less injurious falls would initiate RAs that minimize reliance on others and maximize independence and self-reliance (e.g., use of adaptive equipment). As fall history increases in number and severity, older adults would initiate RAs that include relying on other individuals (e.g., use of personal care assistance, proximity of family).

Design and Methods

Data Source

The Health and Retirement Survey (HRS) is a longitudinal national representative survey, conducted every two years examining health, employment, economic status, and family structure and designed to over sample Hispanics, Blacks, and those living in Florida. Beginning in 1998, the HRS sample was representative of community-living middle-aged and older adults who continue to be reinterviewed every two years. Documentation detailing survey design and methods can be found elsewhere (Hauser & Willis, 2004).

Study Sample

Three observation periods were constructed from pairs of successive HRS data waves: 1998–2000, 2000–2002, and 2002–2004. Fall history and other factors associated with person–environment fit were included as covariates at each baseline wave (e.g., 1998) of each two-wave observation period, and RA outcomes were measured at the outcome wave (e.g., 2000). The time order of events is unambiguous with this variable specification. Any falls and/or incident major health events that are specified in the model occur prior to the measurement of any potential RA. HRS respondents 65 years of age or older who answered the

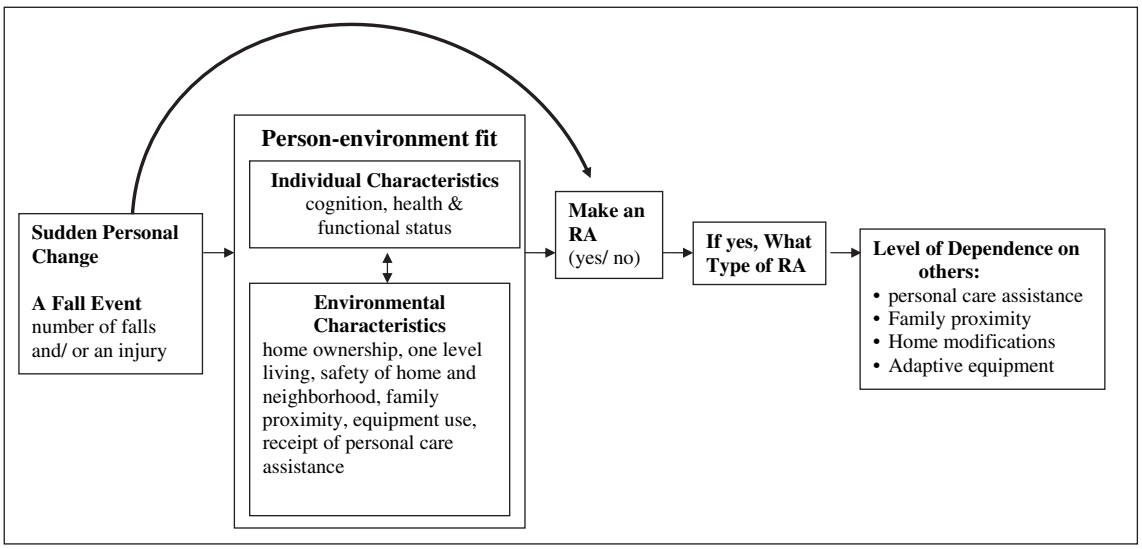

Figure 1. Conceptual model. RA = residential adjustment.

fall history questions at baseline in at least one of the three observation periods were included in the sample for this study. Sample inclusion did not require the respondent to be present in all three observation periods; respondents only had to have complete data in one observation period to be included in the sample. These three observation periods were pooled, resulting in 32,426 person-wave observations.

Observations were excluded if the participant's race was identified as "other" (n = 658), if there was missing data on one or more study covariates (n = 5,083), if there was sample attrition in the follow-up wave for reasons other than death or nursing home placement (n = 1,451), or if the case contained a zero HRS population weight (n = 198). After these exclusions, there were 25,036 observations in the pooled sample. The excluded sample was older ($p < .01$), had lower cognitive function ($p < .01$), lower household income ($p < .01$), and had a lower level of education ($p < .01$) compared with the final sample.

Dependent Variables: RA

RA consisted of two dependent variables and was operationalized using a two-part decision process (Baum & Hassan, 1999; Seek, 1983). The first variable was defined to determine whether any RA was made between the baseline and the outcome year and included (a) yes, an RA was made; (b) no, an RA was not made; or (c) the individual was no longer living in the community due to death or nursing home placement. In the outcome year, participants affirming a change in any RA (receiving additional personal care assistance, receiving additional family support, moving or making home modifications, or using additional adaptive equipment) were classified as having made an RA. Respondents reporting no change in any RAs from baseline to the outcome year were categorized as making no RA.

The second dependent variable was defined only for those respondents who made any additional RA between baseline and outcome year. The presence of existing RAs reported at the baseline interview were included as covariates in the model and did not influence the operationalization of the dependent variable which utilized variables from the outcome year interview. A hierarchal outcome structure was used so that each respondent was assigned to only one of the five RA categories if multiple RAs were made between baseline and outcome year. This hierarchical outcome structure was constructed based on the degree of reliance on another individual(s): (a) increase in personal care assistance with ADL or IADL, (b) a child moving closer to the older adult since baseline (i.e., a child moving into the home or child moving within 10 miles), (c) the older adult moving to an alternate residence or making home modifications, and (d) the additional use of adaptive equipment. Based on the hierarchical outcome variable structure, respondents were categorized as receiving personal assistance if they reported an increase in the current use of personal assistance for one or more ADL and/or IADL in the two years between the baseline and the outcome wave. Respondents not receiving additional personal care assistance, but affirming an increase in household coresidents (i.e., an additional child has moved into the home) or an increase in children living within a 10-mile radius of home, between baseline and outcome wave, were classified as having an increase in the family proximity. Because individuals with no living children are unable to increase the proximity of children, these respondents were excluded (n = 526 observations) from the second analysis, exploring the type of adjustment made. Those individuals with no living children were more likely to be female (63.50% vs. 57.67%), live alone (48.10% vs. 27.99%, $p < .0001$), and have a three or more ADL disabilities (10.46% vs. 6.56%, $p < .001$) than those observations included in the second analysis.

Individuals who had no increase in personal care assistance or family proximity but reported that they made structural modifications to the home or changed residence between baseline and outcome wave were categorized as making physical environmental changes. Respondents reporting none of the previous RAs but an increase in additional or new use of adaptive equipment to walk across the room, to get out of bed, or the use of special safety equipment (i.e., grab bars or shower seat) between baseline and outcome wave were classified as having made an adaptive equipment RA.

Fall History

In the HRS, respondents who are 65 years of age and older are asked whether or not they experienced any falls during the last two years. Those individuals reporting any fall were then asked about the number of falls and whether any falls

resulted in an injury requiring medical assistance. These questions were used to categorize fall history status into one of the four fall status categories: no fall, one fall no injuries, two or more falls no injury, one or more falls with an injury (Tinetti & Williams, 1998).

Covariates

To explore the relationship between fall history and RA, the individual's environment, sociodemographic characteristics (age, gender, race, educational attainment, and household income), health status, functional abilities, and cognitive skills were controlled for in this analysis. Environmental characteristics included a self-rating of poor perceived neighborhood safety, a poor self-rating of the condition of the home environment, living alone, home ownership, and living in a one-level environment. In order to control for existing RAs, variables identifying baseline RAs were included: current use of mobility aids to walk across the room, current use of equipment to get in/out of bed, current use of safety equipment (i.e., grab bars or shower seat), current use of personal care assistance for ADL and/or IADL, and/or having moved to an alternate residence or having made structural modifications to one's home in the last two years. The family proximity present at baseline was defined hierarchically as having (a) a child coresiding in the home, (b) a child living within 10 miles, (c) distant children (reference group), or (d) having no children.

Health status characteristics included self-reported health, body mass index (Strawbridge, Wallhagen, & Shema, 2000), a history of a hip fracture, incontinence, pain (no pain, mild or moderate pain, and severe pain), and self-reported prevalent chronic conditions (diabetes, hypertension, chronic lung disease, heart condition, stroke or transient ischemic attack, arthritis, memory disorder, or psychiatric condition). Because major health events may also trigger an RA in ways similar to falls, variables indicating a new diagnosis of a stroke, diabetes, cancer, heart disease, and lung disease were also included in the model. Self-rated general vision and self-rated distant and near vision were also included. Depressive symptoms were measured utilizing the Center for Epidemiological Studies–Depression Scale (CESD-8; Turvey, Wallace, & Herzog, 1999). An ordinal cognition variable was created utilizing the telephone interview for cognitive status score, immediate word recall, delayed word recall, and proxy questions following the approach of Walsh, Wu, Mitchell, and Berkmann (2003). The use of oxygen due to a chronic lung condition was also included as a covariate because individuals with a chronic lung condition often struggle to maintain independence (Falter, Gignac, & Cott, 2003) secondary to decreased activity tolerance.

In order to control for the presence and severity of disability at baseline, a baseline disability status variable was included. The disability variable was constructed hierarchically and consisted of five categories (Mor, Wilcox, Rakowski, & Hiris, 1994; Porell & Militiades, 2001): independent, functional limitations (e.g., difficulty with at least one: walking several blocks, climbing one flight of stairs, pushing/pulling, stooping/kneeling, lifting 10 lbs, reaching over head, or picking up a dime), IADL disability (e.g., difficulty with at least one: money management, medication management, grocery shopping, meal preparation, phone management), moderate ADL disability (i.e., difficulty with one or two ADL: bathing, dressing, walking across the room, eating, getting out of bed, or toileting), and severe ADL disability (difficulty with more than two ADL).

Statistical Analysis

Multinomial logistic (MNL) models were estimated on the pooled sample data over multiple HRS waves. Pearson and Spearman correlation coefficients were calculated and examined between covariates included in the models. Similar to past research (Porell & Militiades, 2001) using paired survey waves as observations; the STATA 8.0 MLOGIT procedure was used to adjust standard error estimates for parameters to account for repeat observations of the respondents. Utilizing the STATA 8.0 SVYMLOG models were then re estimated to account for the complex survey design of the HRS (e.g., over sampling in specific geographical regions) with robust results. Therefore, the model results are presented taking into account repeat observations of respondents.

Results are first presented for the dependent variable examining the decision to make any RA followed by an analysis examining the second dependent variable the type of RA made. In the first analysis, odds ratios (ORs) are reported for each categorical outcome of the dependent variable (i.e., made any RA and death or nursing home admission) and compared with a common reference

outcome of no RA in the first analysis. In the second analysis, ORs are reported for each outcome (receiving additional assistance with ADL/IADL, making a home modification and/or moving, and using additional adaptive equipment) with a common reference group of increasing the "family proximity."

Results

Table 1 presents the characteristics of the total sample and subsamples of those who did and did not report making an RA during the outcome wave. At baseline, those making any RA reported poorer health (34.5% vs. 22.0%), experienced more injurious falls (11.5% vs. 7.1%), and were less independent (22.9% vs. 35.2%) than those who made no RA. At baseline, those who did make any RA reported using more mobility aids to get across the room (17.4% vs. 6.9%), more safety equipment (18% vs. 10.8%), and received more personal care assistance with ADL (9.0% vs. 2.9%) compared with those who made no RA between baseline and outcome wave.

Table 2 contains the prevalence of each RA reported between the baseline and the outcome wave in the entire sample. Approximately one third of the sample (34.3%) made any RA, 55.1% made no adjustment, and 10.6% died or were admitted to a nursing home. Of those who made any RA, 28.6% increased the use of personal care assistance, 21.2% increased the proximity of family, 32.6% moved or made home modifications, and 10.8% increased the use of adaptive equipment.

Table 3 contains the MNL model results for whether or not an RA was made. As fall history increased in number and the occurrence of an injury, the odds of making any RA increased. Relative to an individual with no reported falls, individuals reporting one fall no injury, two or more falls without injury, or at least one fall with an injury had 17%, 18%, and 26% greater odds of making an RA than those similar individuals who did not make an RA, respectively.

Table 4 shows the relationship between the type of RA made and the fall history. Whereas fall history was significant when predicting any RA, regardless of severity, experiencing an injurious fall was the only fall history variable that significantly predicted the type of RA made. Among individuals making an RA and compared with otherwise similar nonfallers, those with at least one injurious fall had a higher odds of making an RA through the use of additional adaptive equipment (OR = 1.52, 95% confidence interval [CI]: 1.12–2.05) or receipt of additional personal care assistance (OR = 1.34, 95% CI: 1.04–1.73) over increased family proximity.

Discussion

This study examined the relationship between fall history, the number of falls, and the occurrence of a fall-related injury on RAs in a nationally representative sample of community-living older adults. The results support the relationship between fall history and making any RA. Specifically, the occurrence of more falls and injurious falls increased the odds of making any RA compared with older adults with no fall history.

Although reporting any fall was predictive of making an RA, only injurious falls were predictive of the type of RA made. Injurious falls reported at baseline increased the likelihood of making two types of RAs: increasing the receipt of personal care assistance with ADL or IADL and the increased incident use of adaptive equipment. Although experiencing one or more noninjurious falls appears to prompt older persons to make RAs, such falls do not appear to influence the choice among specific protective strategies identified as RAs in this study.

Although this study was not able to examine the beliefs and perceptions of those older adults experiencing one or more falls with no injury, it is possible to hypothesize why the falls not resulting in an injury were not predictive of the type of RA made. Older adults have different perceptions of their own fall risk compared with that of their peers, they often discount their own risk of falling (Stevens, Noona, & Rubenstein, 2010; Yardley, Donovan-Hall, Francis, & Todd, 2006). As a result, older adults may not make specific RAs because of their own perceptions of their noninjurious falls. In addition, the initiation of the decision process to make a change is usually facilitated by an event that is perceived as a life-changing event for the individual (Wiseman & Roseman, 1979). Therefore, older adults may discount a fall or even multiple falls, that do not result in an injury, as events occurring as part of the aging process and not necessitating an RA.

Another hypothesis for the lack of a significant relationship between noninjurious falls and the type of RA made is related to knowledge and access of prevention services. Older adults may not

Table 1. Sample Characteristics ($N = 25,036$)

	Total sample ($N = 25,036$)	Made an RA?	
		No ($n = 13,804$)	Yes ($n = 8,575$)
Fall history, %			
Nonfaller	73	78.3	68.7
One fall no injury	8.5	7.9	9.3
Two or more falls no injury	8.9	6.7	10.5
One or more falls with an injury	9.6	7.1	11.5
Age in years, *M* (*SD*)	74.9 (7.10)	73.6 (6.31)	75.2 (7.15)
Female, %	55.4	54.7	58
Race, %			
White	84.7	86.5	82.5
Non-Hispanic Black	10.2	8.9	11.6
Hispanic	5.1	4.6	5.9
Household income, %			
Lowest quartile	25.3	20.3	29
Second quartile	32	31.9[a]	31.9[a]
Third quartile	26.1	18.9	23.8
Highest quartile	16.5	12.3	15.2
Education in years, *M* (*SD*)	12.1 (3.18)	12.3 (3.01)	11.9 (3.31)
BMI, %			
<18.5	2.7	1.8	2.5
18.5–30.0	78.7	80.3	75.8
>30.0	18.6	17.9	21.7
Fair/poor self-rated health, %	30.1	22	34.5
Fair/poor self-rated vision, %	76.8	18.3	26.3
Fair/poor self-rated distal vision, %	15.5	11.5	17.6
Fair/poor self-rated near vision, %	18.6	14.0	20.9
Cognition, %			
Low cognition	5.6	2.2	6.1
Moderate cognition	58.6	56.7	60.8
High cognition	35.8	41.1	33.1
Hip fracture, %	1.2	0.7	1.6
Incontinence, %	20.6	17.3	23.5
Pain, %			
Mild/Moderate pain	22.6	19.2	26.7
Severe pain	4.8	3.1	6.5
Depression (CESD score > 4), %	12.5	10.0	14.8
History of hypertension, %	55.8	53.4	58.2
History of diabetes, %	14.2	11.7	16.5
History of chronic lung disease, %	3.1	2.9	3.2
History of heart condition, %	7.4	5.6	8.0
History of stroke/transient ischemic attack, %	6.5	4.5	7.7
History of arthritis, %	38.2	40.1	37.2
Psychiatric history, %	12.1	9.6	14.5
New diagnosis of diabetes, %	2.5	2.4	2.4
New diagnosis of lung disease, %	2.9	2.6	3.2
New diagnosis of cancer, %	2.9	2.5	2.6
New diagnosis of stroke, %	2.3	1.6	2.4
New diagnosis of heart condition, %	4.3	3.5	4.7
Memory-related diagnosis, %	2.9	1.0	3.2
Disability, %			
Functional limitation	46.7	49.5	46.9
IADL limitation	5.8	4.4	6.3
Moderate ADL limitation	13.4	8.8	17.1
Severe ADL limitation	5.7	2.2	6.8
Fair/poor self-rating of home, %	8.9	8.0	9.3
Fair/poor self-rating of neighborhood, %	7.6	6.7	8.4

(Table continues on next page)

Table 1. *(continued)*

	Total sample (N = 25,036)	Made an RA?	
		No (n = 13,804)	Yes (n = 8,575)
Living alone, %	27.6	24.9	29.2
One level living, %	43.4	42.2	44.1
Oxygen, %	1.8	0.8	1.8
Home ownership, %	81.2	86.1	77.5
Changes in the physical environment, %	24.9	19.3	33.1
Adaptive equipment, %			
To cross the room	13.9	6.9	17.4
To get out of bed	4.7	2.2	5.5
Safety equipment	14.6	10.8	18
Family support, %			
Child(ren) coresidence	16.4	14.6	19.5
Child(ren) within a 10-mile radius	43.0	46.6	40.3
Child(ren) greater than 10-mile radius	32.9	30.7	40.2
No children, %	7.8	8.1	6.1
Physical assistance IADLs, %	9.8	4.5	12.1
Physical assistance ADLs, %	7.6	2.9	9.0

Note: p Values were calculated using t test for continuous variables and χ^2 test for categorical variables. ADLs = activities of daily living; BMI = body mass index; CESD = Center for Epidemiological Studies–Depression Scale; IADLs = instrumental activities of daily living; RA = residential adjustment.

[a]Variable not significantly different, all other variables significant at $p \leq .001$; comparison between group that made RA and the group that made no RA.

have the knowledge about specific types of RAs, strategies to maximize the person–environment fit, and/or are unaware of/or do not know how to access services which will assist them in identifying the most appropriate RA strategies. It is possible that with more knowledge of fall prevention strategies and RAs, through community programming or other prevention resources, those older adults experiencing one or more noninjurious falls may have greater insight into their fall risk and initiate RAs that could limit their future fall risk. Further research is needed to more fully examine this relationship. With greater insight into the older adult's perceptions, beliefs, and decision-making process, public health programs can design and implement interventions to support proactive RAs.

For community-living older adults who did report a history of an injurious fall, the significant positive relationship between fall history and an RA may be a marker for declining function and the need for assistance or the use of equipment in order to optimize performance through maximizing person–environment fit (Lawton & Nahemow, 1973). Alternatively, these results may also reflect

Table 2. Residential Adjustment Outcome Definitions

Outcome	Definition	%
To make an adjustment or not		
No residential adjustments made	No RA were made between baseline and outcome year	55.1
Any residential adjustment made	An RA was made between baseline and outcome year	34.3
Death or nursing home placement	The respondent entered a nursing home or died	10.6
Type of adjustment made		
Assistance with ADL or IADL	Increase in the number of ADL or IADL receiving assistance	28.6
Family support	No increase in personal care assistance, but family moved closer to the older adult (into the home, within 10 mile radius)	28.0
Moving or home modifications	No increase in personal care assistance, or increase in family proximity, but moved or made modifications to the home	32.6
Adaptive equipment	No increase in personal care assistance, increase in family proximity, or changes to physical environment but did increase use of safety equipment or mobility equipment to get around the house	10.8

ADL = activities of daily living; IADL = instrumental activities of daily living; RA = residential adjustment.

Table 3. Multinomial Logistic Regression of Making any Residential Adjustment (N = 25,036)

	Made any RA[b]	Death or nursing home placement[b]
Fall history[a]	Odds ratio (95% confidence interval)	
One fall no injury	1.17* (1.05–1.30)	1.11 (0.93–1.34)
Two or more falls no injury	1.18** (1.06–1.33)	1.28** (1.09–1.51)
One or more falls with an injury	1.26** (1.13–1.41)	1.30** (1.10–1.52)

Notes. Adjusted for age, race, education, income, body mass index, self-rated health, vision, hearing cognition, chronic conditions, newly diagnosed medical conditions, psychiatric and memory diagnosis, incontinence, history of a hip fracture, persistent problems (lower extremity swelling, shortness of breath, and dizziness), depression, proxy status, pain, environmental factors, exercise participation, disability status, and baseline residential adjustments. RA = residential adjustment.

[a]Reference group = no fall.

[b]Reference group = no RA made.

*p > .05. **p > .001.

the interaction between the older adult and the health care system as a result of the injurious fall. When seeking medical attention for the fall-related injury, the older adult may have received an RA-specific intervention (i.e., the prescribing and/or dispensing of adaptive equipment, such as a cane or walker) and/or referrals for additional services (i.e., physical and/or occupational therapy to facilitate safe use of adaptive equipment) from a health care provider to maximize safety and independence at home. Previous research has identified a relationship between older adults seen in the ER due to a fall and the initiation of changes in the home after receiving fall prevention information (Gerson et al., 2005).

Among those making any RA, 68% had no history of a fall in the previous two years. From this analysis, it is not clear what the motivations were for the initiation of the RAs; whether the initiation was a proactive strategy to limit fall risk or due to an unmeasured life event not captured in this analysis. Further work is needed to examine this group and disentangle whether or not this was a proactive approach to prevention or initiated by life events not captured in this study. If further research finds that nonfallers initiate RAs proactively to limit future fall risk, there is the potential that the knowledge and patterns of this group can influence fall prevention interventions and proactive fall prevention programming.

There were limitations to this study. We examined the relationship between fall history, measured by recall over the previous two-year period at baseline, and initiation of RAs over a subsequent two-year period. Consequently, this long time span can contribute to error in our models even with the attempt to control for variables known to influence the person–environment fit. More specifically, due to limitation of the structure of the HRS, it was not possible to disentangle the sequence of adverse events (e.g., additional falls and changes in health-related characteristics) that occurred between baseline and outcome year in relation to the timing of the initiation of RAs over the same time period. Because of this limitation in the HRS, such adverse events that occurred between baseline and outcome year were not controlled for in this analysis and may have contributed to error in the models.

Table 4. Multinomial Logistic Regression of the Type of Residential Adjustment Made (n = 8,049)

	Personal care[b]	Move or home modification[b]	Adaptive equipment[b]
Fall history[a]		Odds ratio (95% confidence interval)	
One fall no injury	0.92 (0.71–1.19)	0.95 (0.76–1.19)	1.01 (0.74–1.39)
Two or more falls no injury	1.11 (0.85–1.44)	1.06 (0.83–1.34)	1.04 (0.76–1.44)
One or more falls with an injury	1.34* (1.04–1.73)	1.17 (0.91–1.51)	1.52* (1.12–2.05)

Note: Adjusted for age, race, education, income, body mass index, self-rated health, vision, hearing cognition, chronic conditions, newly diagnosed medical conditions, psychiatric and memory diagnosis, incontinence, history of a hip fracture, persistent problems (lower extremity swelling, shortness of breath, and dizziness), depression, proxy status, pain, baseline environmental factors, and disability status.

[a]Reference group = no fall.

[b]Reference group = increase family proximity.

*p > .05.

Similarly, although this was a rich nationally representative data set, we cannot determine from these data if RAs were initiated because of a fall event or for another reason (e.g., change in personal circumstances or declining function). The structure of the HRS survey does not ask respondents if they made the RA after seeking medical attention for a fall, where fall prevention information was administered, as was the case in the study conducted by Gerson and colleagues (2005). Therefore, the HRS does not provide insight into the causal relationship between seeking medical attention for a fall and initiating structural changes through home modifications or moving. The fall history variable, although specific to the type and number of falls, is limited by the mode of administration of retrospective recall, which has the potential for underreporting of fall events. Similarly, the HRS utilizes proxy responses when an individual is identified as being unable to or refuses to participate in the survey, and there is also the potential for differences in self-report among those in the sample with cognitive impairment.

Although our examination of RAs as a two-part decision process has been an approach used in previous studies (Baum & Hassan, 1999; Seek, 1983), it is important to acknowledge that making an RA is not always a systematic decision-making process. Although proximity of family has been discussed in previous literature as being a potential buffer against institutionalization (e.g., Choi, 1996; Litwalk & Longino, 1987), this study was unable to disentangle whether family moved into the home to provide support to the older adult or the older adult provided support to the family member. This study also did not distinguish between formal and informal receipt of personal care assistance with ADL and IADL. Last, it would have been preferable to operationalize death and institutionalization as well as moving and home modifications as separate outcomes; however, the small sample size of these subgroups did not allow for these specifications.

Our study examined RAs in a hierarchical manner, future studies will be needed to expand the analysis beyond individual adjustments and explore making multiple RAs. Understanding the relationship between the fall history and the initiation of a series of RAs and/or combinations of various RAs may provide greater insight into the relationship between fall events and RAs made by older adults and their families. It would also be beneficial to follow respondents prospectively after the initiation of RAs to determine their effect on future falls.

The strengths of this study include the use of a nationally representative sample of older adults to explore the relationship between fall history and RAs. The HRS provided the ability to examine both environmental and personal characteristics and four categories of fall status in the examination of RAs, which have not been included in previous studies. Additionally, sample selection bias was reduced with the integration of death or nursing home placement as an additional outcome.

To our knowledge, this is the first study to examine the relationship between fall history and RAs. RAs may be a strategy utilized by older adults to limit the risk of and/or delay institutionalization. This study found that having a history of injurious falls was a predictor of increasing use of personal care assistance and use of adaptive equipment. There was no significant relationship between noninjurious falls and the type of adjustment made. The challenge for health care professionals and public health providers is to determine the most effective ways to educate and support older adults and families in the RA decision process before an injurious fall occurs. Further research is needed to understand the older adult's perceptions of their fall history, the impact of the health care system, and the financial influences on the types of RAs initiated. As the population continues to age, the initiation of proactive RA strategies prior to first injurious fall may serve as an essential strategy in limiting the risk of institutionalization and maintaining community-based living.

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